

O T T A W A

December 24th, 1941.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1134.


Gold Recovery from the Cobalt-Nickel Ore
from the H. Shakt Mine, Township of Coleman,
Trout Lake Area, Ontario.

=====

IR 1134

10f

BUREAU OF MINES
DIVISION OF METALLIC MINERALS
—
ORE DRESSING AND
METALLURGICAL LABORATORIES


CANADA
DEPARTMENT
OF
MINES AND RESOURCES
MINES AND GEOLOGY BRANCH

O T T A W A

December 24th, 1941.

R E P O R T
of the
ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1134.

Gold Recovery from the Cobalt-Nickel Ore
from the H. Shakt Mine, Township of Coleman,
Trout Lake Area, Ontario.

=====

Shipment:

On November 29th, 1940, a shipment of cobalt-nickel ore was received from the H. Shakt mine for concentration tests. The results of this investigation were covered in our Report of Investigation No. 947, dated January 17th, 1941.

Purpose of the Present Investigation:

On November 20th, 1941, a request was received from J. M. Forbes, Consulting Mining Engineer, Montreal, Quebec,

(Purpose of the Present Investigation, cont'd) -

asking that additional tests be made to determine what recovery of gold could be made from the concentrates prior to shipment.

Investigation Procedure:

Several amalgamation tests were made on the flotation concentrate remaining from the previous investigation.

The remaining portion of the shipment was used to make several new tests. These included jigging, barrel amalgamation, flotation, table concentration, and plate amalgamation.

The remaining portion of the ore was re-sampled and was found to contain 0.86 ounce gold per ton.

Results:

Microscopic examination of the concentrate shows that it contains considerable free gold.

Approximately 30 per cent of the gold in the ore was recovered by amalgamation.

19 per cent of the gold in the ore was recovered when the flotation concentrate was amalgamated.

The results indicate that the gold in the sulphides was not freed at the grind used.

DETAILS OF TESTS:

Tests Nos. 1, 2, and 3. - Amalgamation of
Flotation Concentrate.

The concentrate recovered in Test No. 1, Investigation No. 947, was used for these tests.

Three portions were reground in ball mills with lime, sodium hydroxide, and potassium dichromate respectively. The pulp was then barrel-amalgamated with 10 per cent by

(Tests Nos. 1, 2, and 3, cont'd) -

weight of mercury.

The mercury and amalgam was separated and the three tailings were examined microscopically to determine whether any floured mercury or free gold could be seen. Neither was observed. The mercury appeared clean and bright.

Results:

Test No.	Assay, oz./ton	Recovery of gold, per cent	Remarks
No.	Feed	Tailing	In Test: In Original Feed ⁶ : lb./ton conc.
1	1.58	1.20	24.1 18.6 Lime 10.0
2	1.58	1.34	15.2 11.7 Sodium hydroxide 6.0
3	1.58	1.36	13.9 10.8 Potassium dichromate 6.0

The gold recovered in the flotation concentrate was 77.2 per cent of the gold in the feed, and only 24.1 per cent of this was recovered by amalgamating the flotation concentrate.

It is apparent that only the free gold in the concentrate was recovered by amalgamation. Microscopic examination did not disclose gold in the amalgamated concentrates.

Test No. 4. - Plate Amalgamation of Flotation Concentrate.

This test was made to determine the recovery of gold by plate amalgamation of the flotation concentrate.

The flotation concentrate was made from the ore following the procedure used in Test No. 2, Investigation No. 947.

The concentrate was sampled and divided into two portions, one of which was washed with a solution of sodium hydroxide (5.0 pounds of NaOH per ton of concentrate).

The two portions of flotation concentrate were

(Test No. 4, cont'd) -

then plate amalgamated.

Results:

Flotation.				
Product	Weight, per cent	Assay, Au oz./ton	Distribution of gold, per cent	Ratio of concen- tration
Feed	100.0	0.86	100.0	
Concentrate	52.0	1.51	91.6	1.9:1.
Middling	13.1	0.34	5.2	
Tailing	34.9	0.08	3.2	

Plate Amalgamation of the Flotation Concentrate.					
Test No.	Assay, oz./ton	Recovery of gold, per cent	Remarks		
	Feed	Tailing	In Test	In Original Feed	
4-A	1.51	1.30	13.9	12.7	NaOH - Wash
4-B	1.51	1.36	9.9	9.1	

This test indicates that only the free gold can be recovered on the plate.

The plate did not appear to be adversely affected by this type of feed.

The recovery of gold by flotation was lower than that obtained in the previous investigation. The original tests were made on freshly crushed ore. The remaining portion of the ore used in that investigation has become oxidized, which is probably the cause of the lower recovery.

Test No. 5. - Plate Amalgamation of the Ore Prior to Flotation.

This test was made to determine the recovery of gold by plate amalgamation of the ore.

The ore was ground 90 per cent minus 200 mesh and passed over an amalgamation plate. The plate tailing was

(Test No. 5, cont'd) -

filtered, sampled, and then repulped in a flotation machine.

Reagents:

Conditioning agents -

8.0 pounds of soda ash per ton.
0.5 pound coal tar creosote per ton.

The pulp was agitated for 20 minutes.

Added:

0.4 pound amyl xanthate per ton.
0.1 pound pine oil per ton.

Flotation time, 4 minutes.

Added:

1.0 pound copper sulphate per ton.
2.0 pounds soda ash per ton.
0.6 pound amyl xanthate per ton (In stages).

Flotation time, 22 minutes.

pH of pulp at beginning of flotation - 9.7.
pH of pulp at end of flotation - 9.0.

Total time of flotation, 26 minutes.

Results:

Plate Amalgamation of Ore.			
Assays,	:	Recovery	
Au oz./ton	:	of gold,	
Feed : Tailing	:	per cent	
0.86 :	0.59	31.4	

Flotation of Amalgamation Tailings.					
Product	Weight, per cent	Assay, Au oz./ton	Distribution of gold, In Test	Ratio of concentration	
			per cent	In Original Feed	
Feed	100.0	0.59	100.0	68.6	
Concentrate	46.8	1.07	84.4	57.9	2.1:1.
Middling	25.0	0.28	12.1	8.3	4:1.
Tailing	28.2	0.075	3.5	2.4	

(Continued on next page)

(Test No. 5, cont'd) -

This test indicates that 31 per cent of the gold in the ore can be recovered by amalgamation.

Summary of the Test:

	Per cent
Recovery of gold as amalgam on plate	- 31.4
Recovery of gold in flotation concentrate	- 57.9
Gold remaining in flotation middling and tailing	- 10.7
Total	- 100.0
	Per cent

Test No. 6. - Jig Concentration of the Ore; Amalgamation of the Jig Concentrate; and Flotation of the Jig Tailing.

This test was made to determine the recovery of gold by jiggling the feed and amalgamating the jig concentrate.

A sample of the ore was ground 90 per cent minus 200 mesh and passed through a mineral jig. The jig concentrate was examined microscopically and barrel-amalgamated.

The amalgam and amalgamated concentrate were assayed.

The jig tailing was filtered, sampled, and repulped in a flotation machine. A flotation concentrate was recovered as in Test No. 5.

Results:

<u>Jig Concentration.</u>				
Product	Weight, per cent	Assay, oz./ton	Distribution of gold, per cent	Ratio of concn- tration
Feed *	100.0	0.89	100.0	
Jig concentrate	7.1	5.01	39.9	14.0:1.
Jig tailing	92.9	0.58	60.1	

* The feed assay was calculated from the products.

(Continued on next page)

(Test No. 6, cont'd) -

Amalgamation of Jig Concentrate.				
Product	Weight,	Assay,	Distribution of gold,	
	per	Au	per cent	
	cent	oz./ton	In test	In original feed
Feed	7.1	5.01	100.0	39.9
Amalgam	-	3.71	74.1	29.5
Amalgamated conc.	-	1.30	25.9	10.4

Flotation of Jig Tailing.						
Product	Weight,	Assays,	Distribution of		Ratio of	
	per cent	Au	gold, per cent		concentration	
	Test	Orig. feed	oz./ton	Test	Orig. feed	
Feed	100.0	92.9	0.58	100.0	60.1	
Concentrate	49.2	45.7	1.08	91.8	55.2	2.0:1.
Middling	16.9	15.7	0.16	4.7	2.8	5.9:1.
Tailing	33.9	31.5	0.06	3.5	2.1	

Summary of the Test:

	Per cent
Gold recovered as bullion in amalgam	29.5
Gold in amalgamated concentrate	10.4
Gold in flotation concentrate	55.2
Gold in flotation middling and tailing	4.9
Total	100.0
	Per cent

The jig concentrate contained considerable free gold. Lime was used in the barrel-amalgamation (10 pound lime per ton of concentrate); no floured mercury was seen in the amalgamated concentrate.

In practice the amalgamation concentrate would be returned to the ball mill or to the classifier to recover the remaining values by flotation; or, if the grade is sufficiently high, it can be added directly to the final concentrate.

In this test, 7 per cent of the feed was barrel-amalgamated instead of approximately 50 per cent when the

(Test No. 6, cont'd) -

whole flotation concentrate requires amalgamation.

Test No. 7. - Flotation followed by Table Concentration of the Flotation Concentrate; Amalgamation of the Table Concentrate.

This test was made to determine the recovery of gold by amalgamating a table concentrate recovered from a flotation concentrate in order to avoid amalgamating a large bulk of flotation concentrate.

A sample of the ore was ground 90 per cent minus 200 mesh and floated similarly to Tests Nos. 5 and 6.

The flotation concentrate was then concentrated on a Wilfley table.

The table concentrate was reground with 10 pounds of NaOH per ton and barrel-amalgamated.

Results:

Flotation of the Ore.				
Product	Weight, per cent	Assay, oz./ton	Distribution of gold, per cent	Ratio of concen- tration
Feed ^a	100.0	0.73	100.0	
Flot. concentrate	51.3	1.30	90.8	1.95:1.
Flot. middling	12.6	0.19	3.3	7.9:1.
Flot. tailing	36.1	0.12	5.9	

^a The feed assay was calculated from the products.

Table Concentration of the Flotation Concentrate.						
Product	Weight, per cent	Assays, oz./ton	Distribution of gold, per cent	Ratio of concen- tration	Test: Orig. feed	Test: Orig. feed
Feed	100.0	51.3	1.30	100.0	90.8	
Table conc.	19.0	9.7	2.95	43.0	39.1	5.3:1.
Table middling	33.3	17.1	1.02	26.1	23.7	3.0:1.
Table tailing	47.7	24.5	0.84	30.9	28.0	

(Continued on next page)

(Test No. 7, cont'd) -

Barrel-Amalgamation of Table Concentrate.			
Products	: Assay,	: Distribution of	
	: Au	: gold, per cent	
	: oz./ton:	In test:	In orig. feed
Feed	: 2.95	100.0	39.1
Amalgam	: 1.45	49.2	19.2
Amalgamated conc.	: 1.50	50.8	19.9

Summary of the Test:

	Per cent
Gold recovered as bullion in amalgam	19.2
Gold in amalgamated concentrate	19.9
Gold in table middling and tailing	51.7
Gold in flotation middling and tailing	9.2
Total	100.0
	Per cent

No floured mercury or free gold could be seen under the microscope when the amalgamated concentrate was examined.

The mercury appeared clean and bright and was recovered without difficulty.

Summary:

Amalgamation of the flotation concentrate gave recoveries/ ^{of} from 10 to 19 per cent of the gold in the feed.

Plate amalgamation of the ore prior to flotation gave a recovery of 31 per cent of the gold in the feed.

Amalgamation of a jig concentrate gave a recovery of 29.5 per cent of the gold in the feed as bullion.

Conclusions:

Due to the low ratio of concentration the flotation concentrate recovered from this ore is very bulky and would result in having to treat approximately 50 per cent of the weight of the feed by barrel-amalgamation.

In order to overcome this difficulty and recover the free gold it is suggested that a mineral jig be inserted in the ball mill-classifier circuit to recover the gold before it reaches the classifier or the flotation circuit. This will produce a high ratio of concentration and the feed to the amalgam barrel will be less bulky.

The amalgamated jig concentrate should then be returned to the classifier or if the grade is sufficiently high it could be added directly to the final concentrate.

The gold liberated from the gangue and metallic mineral will be recovered by amalgamation. The gold included in the dense metallic minerals cannot be recovered by amalgamation but would report in the cobalt-nickel concentrates.

ooooooooooooo
oooooo
oo

WSJ:GHB.